# Space Weather Technical Forecast

Issued on Friday, 26 November 2021 at 12:06 Local

**This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

## Space Weather Forecast Headline: Chance of G1 from 24 November CME later this UTC weekend. Filament eruption observed from northeast quadrant in period, with analysis in course.

### Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar activity has been Very Low over the past 24 hours, with no significant X-ray flares. There are currently up to four active regions on the visible disc, although one has not persisted long enough to warrant numbering at the time of writing (appearing as a very faint western hemisphere bipolar group). There are two confirmed new sunspot regions, 2899, which has persisted as a faint Bxi/Beta in the southwestern quadrant in the period, as well as 2900, a growing Bxi/Beta that leads the longer-standing 2898. This final region showed a further growth trend in the 24 hours, with proliferation in its intermediate portions implying its hitherto Cao classification may now warrant a Cai/Beta. Despite its growth, as stated, no signifcant flares were observed.

At 26/0010UTC, a faint but impulsive filament eruption was seen in H-alpha imagery as well as some SDO EUV wavelengths (e.g. AIA 304), leaving the northeastern quadrant. Imagery for the relevant period is scant until a significant distance from the solar disc, by which time its faintness has rendered analysis difficult. Cursory assessment suggests that the ejecta may be largely directed above and behind the path of Earth in its orbit, however this will be re-assessed when imagery allows.

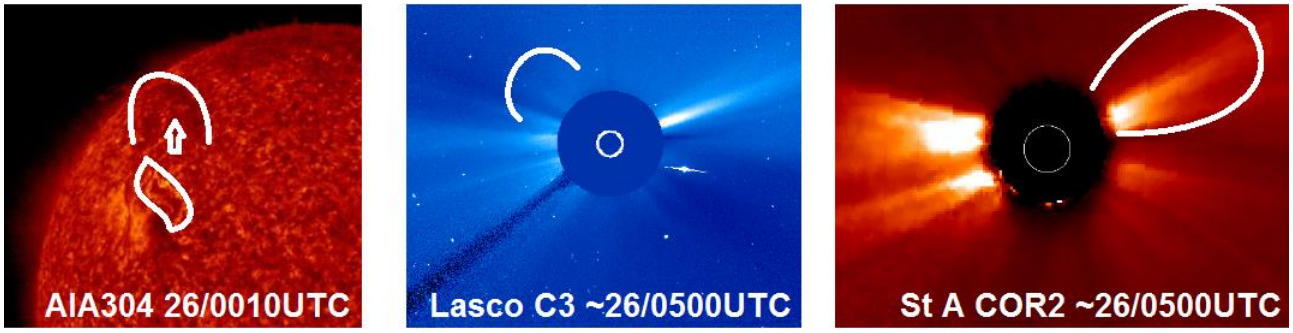


**Figure 0: A northeast quadrant filament eruption and resulting coronagraph imagery for the ensuing hours. The attribution in each coronagraph is not certain, and analysis of the event is underway, although cursory assessment suggests this event is mostly above and behind the Earth in the path of its orbit.**

No other events spawning potentially Earth-directed CMEs were identified in available imagery.

**Solar Wind / Geomagnetic Activity:** The solar wind evolved from the remnants of a fast regime to become slow in the period, probably signalling the end of the influence of coronal hole 20.

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The solar wind speed, as measured by DSCOVR at L1, fell from early highs near 450km/s to settle about 350km/s by the period's end. The solar wind density fell and then rose within single figures ppcc, while the IMF peaked at just 5nT, with a north-south range between +/-3nT, albeit often weakly anti-aligned with Earth's field. The phi angle remained predominantly negative, despite the exit from CH20/- (towards the sun).

The net result of the above solar wind measures was provisionally Quiet Kp throughout.

**Energetic Particles / Solar Radiation:** The high energy proton flux (greater than 10 MeV) remained at Background levels.

The high energy electron flux (greater than 2 MeV) was predominantly at Moderate levels, just touching High levels, with 1000pfu recorded fleetingly at 25/1150UTC. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), with a roughly level trend, reaching 3.78e7 integrated pfu at 26/0000UTC.

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Solar activity is expected to be Low or Very Low, with a daily 20% Chance of C-class flares, although the recent growth trend of AR2898 will be monitored.

**Solar Wind / Geomagnetic Activity:** The 26/0010UTC filament eruption in the northeast requires further imagery to analyse, but appears largely directed above and behind Earth's orbital path. Otherwise, an earlier CME from a filament eruption leaving the Sun 24/1300UTC may reach Earth late Saturday 27, possibly early Sunday 28 November. There is considered to be a Chance of G1 from this event, probably peaking within the UTC day of Sunday 28 November (Day 3).

Quiet geomagnetic activity is otherwise expected, although there is a Chance of some unsettled periods should CH22/- become geoeffective into the coming UTC weekend, with the timing/presence of this aspect low confidence, even if the expected magnitude of effects is more certain (in being small).

**Energetic Particles / Solar Radiation:** The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels. The high energy electron flux (greater than 2 MeV) should now remain roughly level or weakly diminutive for lack of further significant enhancements in the period, perhaps showing a late uptick from any incident CME over the UTC weekend.

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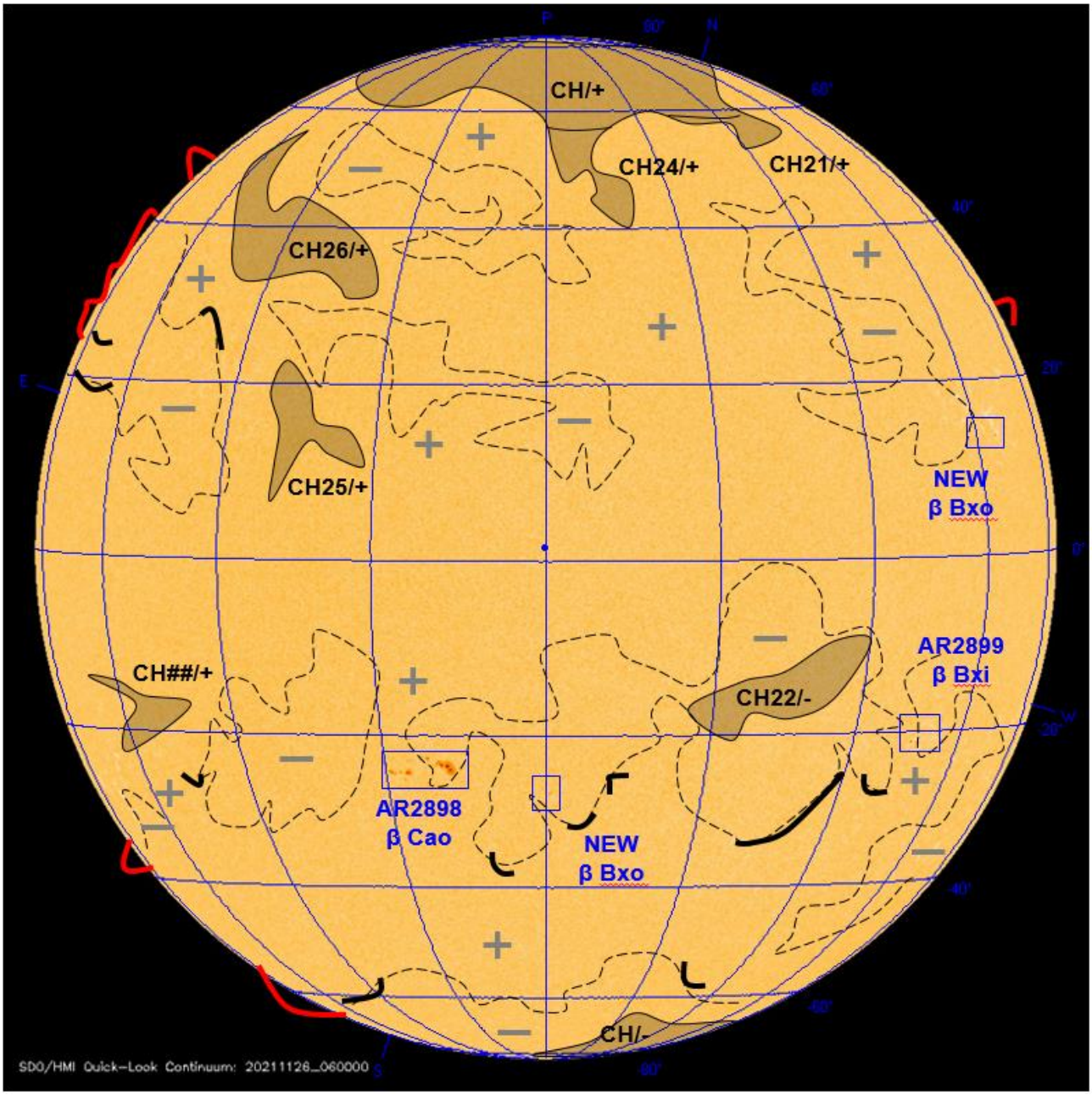
**Figure 1. Solar Analysis Valid 26/0600UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

The 26/0010UTC filament eruption in the northeast requires further imagery to analyse, but appears largely directed above and behind Earth's orbital path. Otherwise, an earlier CME from a filament eruption leaving the Sun 24/1300UTC may reach Earth late Saturday 27, possibly early Sunday 28 November. There is considered to be a Chance of G1 from this event, probably peaking within the UTC day of Sunday 28 November (Day 3). The trend in recent MOSWOC Enlil runs has been to reduce the peak solar wind density experienced by Earth from this event, implying a weaker onset, although the reasons for this are not clear. The preferred deterministic solution remains relatively central in terms of arrival time and magnitude in the MOSWOC Enlil ensemble, and previous thoughts are therefore maintained, with the bulk of geomagnetism most likely to fall in the UTC day of Sunday.

Quiet geomagnetic activity is otherwise expected, although there is a Chance of some unsettled periods should CH22/- become geoeffective into the coming UTC weekend, with the timing/presence of this aspect low confidence, even if the expected magnitude of effects is more certain (in being small). there is now increased confidence in the northern crown extensions not properly manifesting at Earth, despite their probable appearance in STEREO A in recent days.

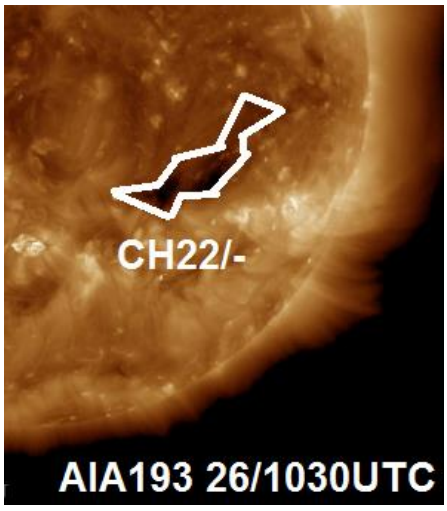


**Figure 2: AIA193 imagery showing likely minor coronal hole 22. This may connect with Earth in the period, but is likely to be unremarkable in terms of geomagnetism.**

| Geo-Magnetic Storm<br>Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 10 | 30 | 1 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

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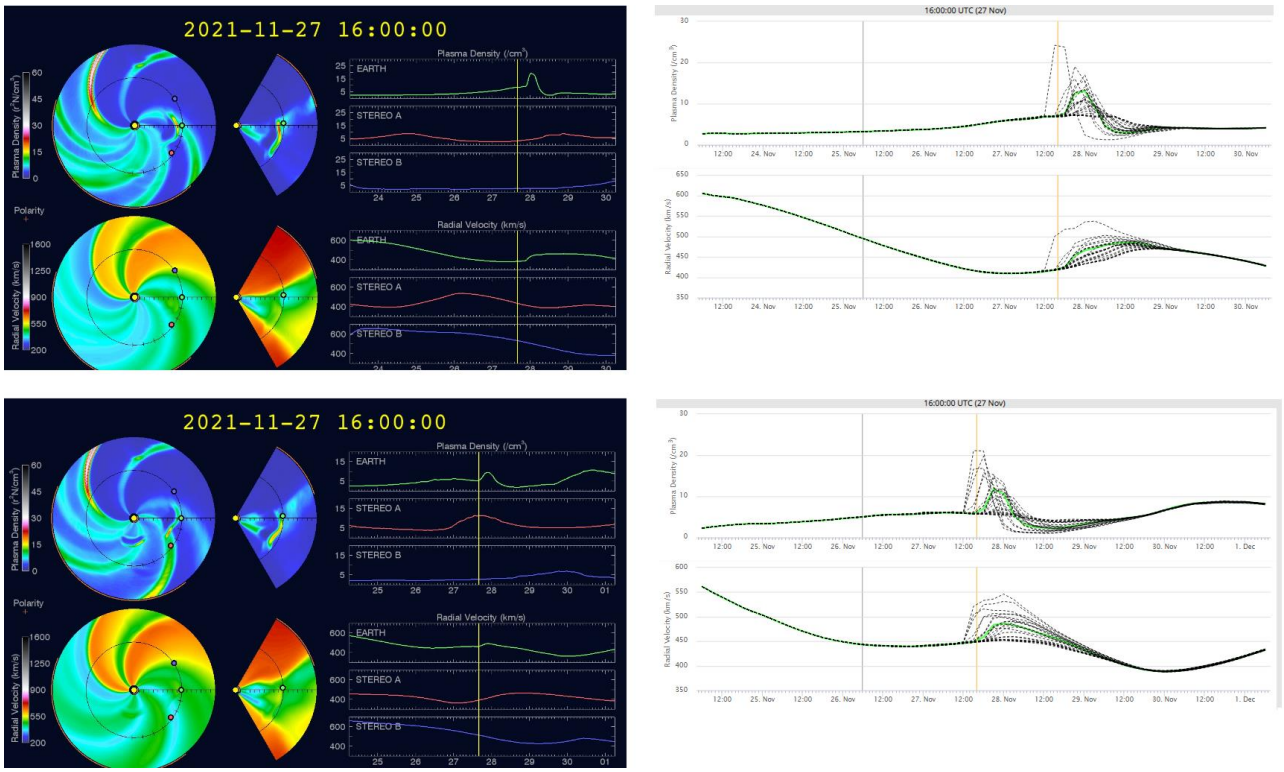
## Geomagnetic Activity - Earthbound Coronal Mass Ejections

| Date/time 21.5R (UTC) | Halo: Full or Partial | Source | Source Location | Estimated Speed | Estimated Arrival Time | Comments |
|---|---|---|---|---|---|---|
| 24/2058UTC | Partial Halo | Filament Eruption | SE Quadrant | 500 | 27/2300UTC | Mainly angled behind and below Earth. |

**Figure 3: 25/0600UTC MOSWOC Enlil and 26/0600UTC runs, complete with ensembles. The trend between runs has been to reduce the magnitude of the impact (for being less dense) although the mechanism for reaching this conclusion is unclear. The arrival time remains unchanged, with the magnitude also falling centrally in each ensemble.**

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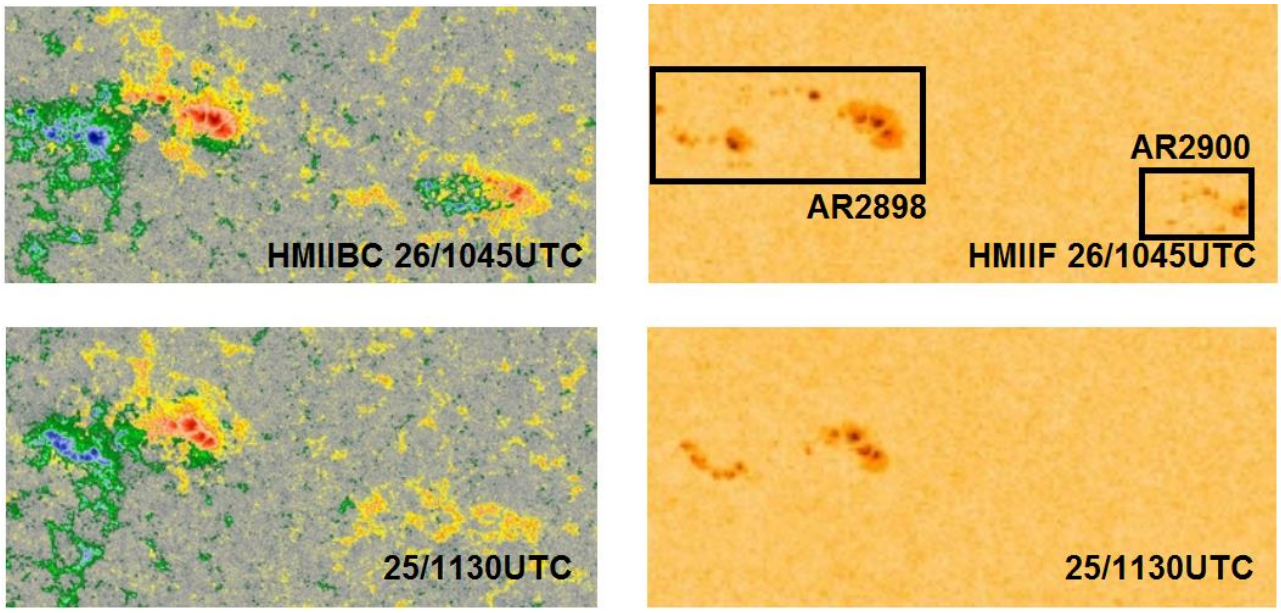
## Radio Blackouts - X-Ray Flares:

There are now up to four sunspot regions on the visible disc, however the most pertinent remains the oldest - AR2898. This group has seen some proliferation in its intermediate portions in the past 24 hours, and, while this has yet to translate into significant flare activity, the risk has slightly increased.

The eastern solar horizon may reveal the returning Carrington location for Ex-2893 shortly, and perhaps a possible new region later in the UTC weekend showing as bright flux to the east of this. Judgment as to any increase in flare risk is withheld for now until these show on the Earth-facing side, and the risk of significant flares is therefore very low at present, with the caveat of needing to monitor AR2898's growth.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 1 | 1 | 1 | 1 |
| Very Active | R3 to R5 X Class | No | 1 | 1 | 1 | 1 |

**Figure 4: Time evolution of the two centre-disc sunspot groups, including newly-numbered 2900. This latter region is responsible for a minor uptick in X-ray flux to end the period.**

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## Solar Radiation Storms - (High Energy Protons):

In the absence of any significant flare activity, the high energy proton flux (greater than 10 MeV) is forecast to remain at background levels, with no solar radiation storms anticipated.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 1 | 1 | 1 | 1 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

## High Energy Electrons Event (≥ 2MeV):

Mechanisms for increasing high energy electron flux are now expected to be in short supply, with Earth having finally exited the high speed stream from coronal hole 20 in the past 24 hours. As stated, any influence from succeeding coronal hole 22 is expected to be minor if present, and unlikely to prove capable to generate Active 24-hour integrated fluence. the biggest uncertainty in the period is therefore any response to the 24 November CME's arrival over the weekend, with note also taken of another possible event at 26/0010UTC - with these increasing uncertainty in electron levels into the next working week.

| GEO Electron Environment Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | No | 1 | 1 | 1 | 10 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 1 | 1 |

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